MIT REAP
Regional Entrepreneurship Acceleration Program

University of Strathclyde Business School

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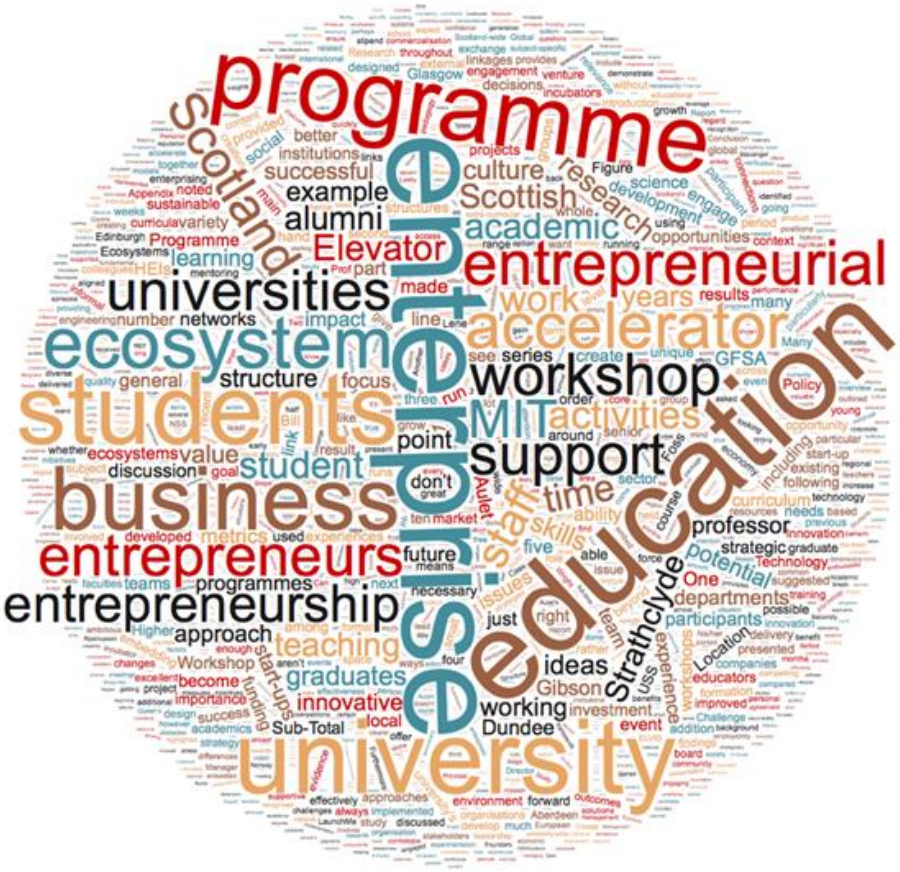
Iomairt na Gàidhealtachd 's nan Eilean

Growing Entrepreneurial Ecosystems: A Handbook for HEIs

Final Report December 2018



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Executive Summary

Scotland has an ambitious goal to become a world-leading entrepreneurial and innovative country. As part of these efforts, Scotland participated in the MIT Regional Entrepreneurship Acceleration Program (REAP) from 2012 to 2014. A key issue identified by REAP was the role of Higher Education Institutions (HEIs) in Scotland's innovation-driven entrepreneurial ecosystem. While HEIs have accelerated their engagement with industrial and other external partners and promotion and support of entrepreneurial behaviour among students and staff, particularly in recent years (Universities Scotland, 2018a), the REAP Scotland report identified that there was scope to share best practice.

Funded by Highlands and Islands Enterprise (HIE) and led by REAP core team member Prof Jonathan Levie (University of Strathclyde) and the REAP Universities High Level Task Group (UHLTG), four interactive and practice-oriented best practice workshops were conducted to address this issue: 'Mapping University Ecosystems' (2015, University of Dundee), 'Incubators and Accelerators' (2015, Elevator, Aberdeen), 'Enterprise Education' (2016) and an 'Ecosystem Exchange Activity' (2018), both at the University of Strathclyde, Glasgow).

On the basis of these workshops and the state-of-the-art of the academic literature on entrepreneurial universities, this report presents a process-oriented framework for HEI entrepreneurial ecosystems to nurture entrepreneurial activities among staff, students, and graduates. HEI entrepreneurial ecosystems emerge from the "strategic and collective actions of various organizational components […] in order to maximize both the entrepreneurial and innovative contributions of universities" (Hayter, 2016, p. 634). To enable this:

1. HEIs should understand their own entrepreneurial ecosystem and create a supportive environment for its development. This environment includes an entrepreneurial and innovative culture; policies that support and reward entrepreneurial activities; and efforts to connect staff, students, and alumni; all coordinated and promoted through a clear vision and strategy.
2. HEIs should develop clear internal pathways for entrepreneurial staff, students and alumni and constantly monitor their effectiveness and adjust if necessary. Many HEIs offer a variety of programmes and different ways of supporting entrepreneurial students, staff and alumni. The challenge for most HEIs is to provide a clear path for their constituents in order to help them navigate through the opportunities and resources that are available to them.
3. Technology-based ventures typically need more resources than a HEI on its own can provide. At the other end of the spectrum of external resource need, artists and

freelancers can also benefit from connections to the wider ecosystem. HEIs therefore need to collaborate with the wider ecosystem to leverage additional resources. For HEIs, it is important to show how engaging with external organisations can be valuable, to whom they are of value, and how and when this fits within the internal pathway. Furthermore, many HEIs have a particular regional mission. As entrepreneurial ecosystems are increasingly recognised to be regional rather than national phenomena, some HEIs have the opportunity to become leading stakeholders in the entrepreneurial ecosystem of their city or region.

We extend those three recommendations and provide a more holistic perspective for Scottish HEIs as a group, enabling them to contribute more to Scotland's entrepreneurial ecosystem, to implement sustainable policies and structures that link to current national policies, and incorporate lessons that other institutions have learned from experience. In particular, HEIs should take the following steps:

1. There is a continuing need to cultivate collaboration among HEI enterprise-related staff at all levels and between them and relevant ecosystem stakeholders such as the Scottish Institute for Enterprise and entrepreneurial alumni. While innovativeness at the institutional ecosystem level is a necessary ingredient, it is not sufficient. If individual HEIs, like other wider ecosystem stakeholders, are too focused on their own activities and policies, their efforts will remain fragmentary and undervalued.
2. The standard metrics are "convenient to collect, keep the funding bodies happy but do not tell you much about what is really happening" (Graham, 2014, p. 8). While metrics cannot be avoided for HEIs, learning, skills and education must be at the heart of all metrics and both business formation (quantity of entrepreneurship) and start-up performance (quality of entrepreneurship) should be secondary objectives.
3. A more radical concept raised by some participants is ecosystem experimentation, perhaps funded by a prize fund where proposals for experiments that could enhance HEI entrepreneurial ecosystems. Results would be published and successful experiments could be replicated or adapted across the HEI community.

While a small series of workshops and events cannot cover all challenges and opportunities, the discussions during the workshops have shown that this series has addressed at least some of the key enterprise issues facing Scottish HEIs. Feedback from all four workshops was very positive. Overall, participants recognised the value in working with like-minded people at different levels in different organisations, the opportunity to make new connections, establish relationships, and to exchange ideas, best practices and learn from each other.

Acknowledgements

The authors are grateful to Highlands and Islands Enterprise (HIE) for financial support and encouragement, and to Clive Reeves of Scottish Enterprise for helping to create the Universities High Level Task Group (UHLTG) following the REAP report. The UHLTG members were (in alphabetical order): Professor Jon Cooper (University of Glasgow), Professor Sir Pete Downes (University of Dundee), Professor David Lane (Heriot-Watt University), Professor Jonathan Levie (University of Strathclyde, chair), Professor Andy Porter (University of Aberdeen), and Professor Ian Underwood (University of Edinburgh). We are grateful to members of the UHLTG for their inspiration in suggesting themes for the workshops and for hosting, supporting and encouraging staff to attend them.

We thank the workshop speakers, including Professor Lene Foss of the University of Tromsø, Andy Campbell and Graham Malcolm of Elevator, Lucy-Rose Walker of Entrepreneurial Spark, Thibaut Rey, Director of Synchronise, Bill Aulet, Director of the Martin Trust Center for Entrepreneurship at MIT and Professor David Gibson, Head of Entrepreneurship Education at Liverpool John Moores University.

We thank all who participated in the workshops and entered into the spirit of collaborative learning across HEIs, work roles and levels of authority.

Finally, we would like to thank Ross Croall (University of Strathclyde) for his assistance in preparing, running, and analysing the “Enterprise-for-All” workshop in Glasgow.

The text in this report represents the views of the authors and not necessarily any individual or organisation acknowledged above.

The word cloud on the front cover represents a frequency count of the words in the individual reports on the four workshops in this series.

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1. Introduction

Scotland has an ambitious goal to become a world-leading entrepreneurial and innovative country (Scottish Government, 2013). As part of these efforts, Scotland participated in the MIT Regional Entrepreneurship Acceleration Program (REAP) from 2012 to 2014.[1] The Scottish REAP core team identified several strengths and weaknesses of the wider Scottish ecosystem in collaboration with other stakeholders and developed an action plan and initiative to stimulate the environment for innovation-driven entrepreneurship (IDE). The Scottish higher education (HE) sector, with five universities among the top 200 universities and twelve Scottish universities among the top five per cent in the world, is often seen as a key strength of Scottish society and its economy (Universities Scotland, 2018b). However, in focus group discussions with stakeholders in Scotland's entrepreneurial ecosystem, the REAP group identified that actions were needed to leverage the role of Scotland's universities to improve entrepreneurship and management education and build links with alumni to foster mentoring, support and development of Scotland's ambitious entrepreneurs (Chisholm et al, 2014, p.5).

While many HEIs have developed approaches to further increase their engagement with industrial and other external partners and promoting and supporting entrepreneurial behaviour among students and staff, this is often a result of internal trial-and-error, due to a lack of sharing of best practice. As part of the implementation phase of the REAP programme, a series of best practice workshops was conducted to address this issue. Funded by Highlands and Islands Enterprise (HIE), these workshops were led by REAP core team member Prof Jonathan Levie (University of Strathclyde) and the Universities High Level Task Group (UHLTG). Seven topics were proposed initially to the UHLTG, who were also asked to propose additional topics, and a consensus was reached on the following topics and workshops:

- Mapping University Ecosystems (2015, University of Dundee)
- Incubators and Accelerators (2015, Elevator, Aberdeen)
- Enterprise for All (2016, University of Strathclyde, Glasgow)
- Ecosystem Exchange Event (2018, University of Strathclyde, Glasgow)

The workshops were designed to share best practice in critical areas of HEI entrepreneurial ecosystems that are currently regarded as weak overall across the Scottish university system, but where pockets of best practices inside and outwith Scotland are known to exist.

[1] For further information see http://reap.mit.edu/cohort/scotland/.

The workshops brought relevant individuals at all levels of authority from different Scottish HEIs together in the same room to learn from each other and gain inspiration. For each workshop, the entrepreneurial professors from the UHLTG invited stakeholders in their organisation who are relevant to the theme of the discussion. Over time, additional relevant individuals in other Scottish HEIs were identified and invited and staff from 12 different Scottish HEIs plus the Scottish Institute for Enterprise were represented in at least one workshop. Individual reports containing the key insights and discussion points were distributed among all participants and the UHLTG. Figure 1 provides a word cloud of these four intermediate reports to give a sense of the overarching themes and issues.

This report provides a comprehensive overview of all workshops, including background information, objectives, and summaries. The aim is to synthesise these insights and lessons learned into a manual for universities on how to implement these best practices and tailor them to their particular circumstances. Lastly, we provide next steps to continue the discussion and exchange activities among universities for nurturing their own university ecosystems and improving the integration into their local entrepreneurial ecosystem and the wider Scottish ecosystem.

Figure 1: Word cloud based on frequency counts of words in the four workshop reports

2. Workshop Summaries

The four workshops of this series were each structured around specific issues that were deemed to be of most importance to all Scottish HEIs by the UHLTG. The idea for each workshop was that Scottish HEIs learn from each other and, where relevant, from elsewhere (i.e. international best practice). A striking feature of the workshops was that participants were drawn from every level in the typical HEI hierarchy – from senior management to programme assistants, and from senior faculty to entry level professional services officers. Renowned speakers from within and outside the Scottish HE system formed the foundation of each of first three workshops, while allowing time for all participants to engage in practical exercises and discussion. The final workshop was designed purely as an ecosystem activity exchange event. This chapter provides a short summary of the individual workshops, including the design and structure, main topics, and keynote speakers.

2.1 Mapping University Ecosystems (Dundee)

The first workshop of this series was held at the University of Dundee on 14th September 2015. The workshop was deliberately designed as very interactive to give participants the opportunity to reflect on their own ecosystem, its configuration and different ways to map it. In this interactive setting, it was possible to get a first overview of the challenges and issues that Scottish HEIs face with regard to their entrepreneurial activities.

Prof Sir Pete Downes, Principal and Vice-Chancellor of the University of Dundee, welcomed all participants and provided insights and background information about the host university and its ecosystem. He emphasised the creation of the university-wide vision “transforming lives locally and globally” in Dundee, on the view that research should have an ultimate purpose. The University of Dundee has a successful track record of entrepreneurial activities in many fields, including health, life sciences, energy, and design, but he stressed that he sees graduates as its most important output.

Prof Lene Foss (University of Tromso, Norway) presented findings from her book that featured the analysis of and lessons learned from ten entrepreneurial universities in the US, UK, Finland, Norway and Sweden (Foss & Gibson, 2015). Similar to the variety of approaches presented in the book, this workshop highlighted both the innovativeness of Scottish HEIs in developing broad range of solutions but also a lack of sharing with each other what works to avoid duplicating mistakes and integrating lessons learned. A key challenge that emerged during the discussion was the challenge of understanding and mapping a university ecosystem with its many interacting parts and how to identify the

linkages and mechanisms that are missing. In mapping their ecosystems, participants Identified issues including coordinating efforts across faculties and a lack of embeddedness of business schools, mirroring wider research on this topic (e.g. Wright et al., 2009).

2.2 Accelerators (Aberdeen)

While the first workshop focused on the university ecosystem as a whole, the second one emphasised one particular part of an ecosystem that was gaining increasing attention at the time: accelerators. The workshop was held in an accelerator (Elevator) in Aberdeen on 1st December 2015 and provided all participants with an opportunity to visit and experience the environment of an accelerator in Scotland. Andy Campbell, Accelerator Project Manager at Elevator, welcomed all participants on behalf of the whole Elevator team and provided a brief overview of its history and status quo. Formerly known as Enterprise North-East Trust, Elevator runs the business gateway contract in Aberdeen(shire) and Dundee/Perth with 1200-1500 companies per year as well as an accelerator. Elevator is a non-profit organisation that solely relies on partners and sponsors and the accelerator doesn't take any equity in companies or bill them. However, it doesn't provide a stipend for its participants either. It is a member of the Global Accelerator Network (GAN) and has, hence, access to an international network and a variety of resources. Elevator focuses on high-impact businesses as there is no need to accelerate lifestyle businesses such as a cupcake shop. Opportunities for collaborations with other accelerators have been turned down because of this specific focus. Elevator has become the hub and a focal point for all sorts of entrepreneurial events and activities in Aberdeen, in common with support organisations in many ecosystems (Bliemel et al., 2018)[2].

Bill Aulet, managing director of the Martin Trust Center for MIT Entrepreneurship at MIT and Professor of Practice at MIT Sloan School of Management, presented a general overview of accelerators, the differences to incubators, and particular experiences from MIT. At the time of the workshop, MIT was running the Global Founders Skills Accelerator as an academic accelerator that particularly focuses on boosting skills (Aulet, 2014). The programme is funded with five million dollars over five years by an alumnus. GFSA is not a science project, it is designed to prepare students for what entrepreneurship is really about. Especially when seen as an educational programme, the main impact of an accelerator is not the generation of start-ups, but the education of entrepreneurs with the right skills and the mind-set and psychology that it takes to succeed. Key insights from the MIT experience include the

[2] In autumn 2017, Elevator opened a Centre for Entrepreneurship on the University of Dundee campus in a partnership with the University.

opportunity to pay participating students during the semester break so that they can focus on their ideas full-time.

2.3 Enterprise-For-All (Glasgow)

The third workshop in the series was held at the University of Strathclyde on 25th August 2016. Thirteen workshop participants represented seven different HEIs plus the Scottish Institute for Enterprise, including two from HEIs represented in the series for the first time. This workshop focused on best practices in embedding and managing enterprise education as widely as possible throughout a HEI's curricula and how this linked with extra-curricular student programmes. Prof Jonathan Levie welcomed the participants to Glasgow and introduced Prof David Gibson OBE, Head of Entrepreneurship Education at Liverpool John Moores University.

Prof Gibson has previously held positions of Senior Teaching Fellow and Visiting Professor at Queen's University Belfast, and, in addition to academic work, has over two decades of experience in the enterprise consultancy sector. His success in embedding enterprise education beyond the departments of the business school is well demonstrated by the fact that, by the end of his time at Queen's, roughly 85% of graduates (across all university disciplines) were leaving the university with a certificate that recognised their participation in enterprise education. He has developed a strategic framework for embedding enterprise education that he calls the "ELVIS" model. This framework identifies the most foundational aspects of embedding enterprise education throughout the wider university curricula:

- **E**mbedding enterprise education for all
    - Enterprise education must be made available for students of all disciplines within the university. Its relevance to even the most remote subject must be made clear.
- **L**inkages between all facets of the entrepreneurial ecosystem
    - In order to increase effectiveness and efficiency, robust linkages must be made between all facets of the university's entrepreneurial ecosystem. All stakeholders must be incentivised and encouraged.
- **V**alue of enterprise education/Verify your outcomes
    - The value of enterprise education must be made clear at every level, from the student body up to the level of sector policy-makers. One way of doing this is through robust verification, where data is collected on outcomes and then used to validate programme value.
- **I**nnovative pedagogy/Institutional support

- Enterprise education will flourish best when an engaged subject-specific delivery team form an innovative pedagogy best suited to the students in their field. The institution must support this in any way that it can.

- **S**tudent-centred with engagement from alumni
  - The programme should be student-centred with emphasis placed on how students benefit going forward into their post-university careers, even if this doesn't necessarily manifest through the establishment of their own start-up. Active engagement with alumni will result in content verification and improved future delivery of the programme.

In order to support these activities, Professor Gibson has identified four self-reinforcing "enablers". These start with a thorough engagement of the student body using a customised programme which is well-tailored to each subject. The impact of the programme is measured using the E-factor survey (Gibson, 2006; see also Appendix A1), the results of which are used to market the programme to other departments and to improve programme content being delivered in future.

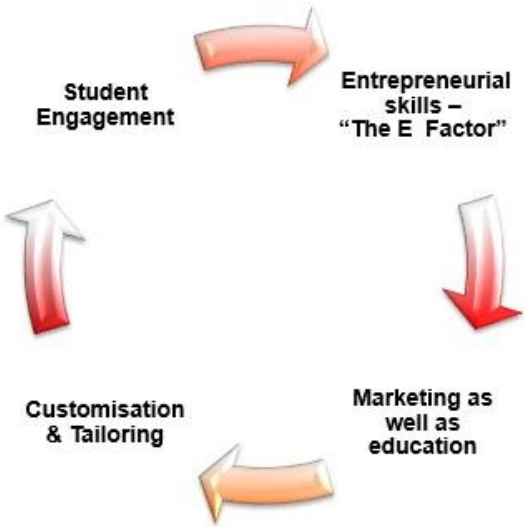

Figure 2: Enablers for enterprise education (Gibson, 2006)

The ensuing discussion highlighted three general issues. The first focused on the need to effectively engage with colleagues and to persuade them of the beneficial nature of the enterprise programme (especially those colleagues in departments where the benefits and even relevance of enterprise education aren't initially clear). One potential initial target included those who were already recognised (perhaps in awards or in NSS results) as excellent teachers – it was possible that their approach could be already well aligned with enterprise education principles and approaches, and they could become bridgeheads or

beacons for their faculties or departments, helping demonstrate the value of enterprise education. Another potential initial target could be those teachers or departments who are demonstrably not doing well in teaching, and who might be looking for solutions.

Secondly, participants suggested means through which enterprise educators could better engage with (and receive support from) the formal structures of the university and education sector. Getting buy-in from university vice principals of teaching and learning by showing how enterprise education aligned with the HEI's own strategy, or with external assessments of teaching quality, and working with in-house teacher training units were three options under this strand. Lastly, participants identified the need to better track programme outcomes so that its true worth to the student body and the university can be empirically demonstrated. The E-factor questionnaire is one option as it has been validated and tracked over a 10-year period at Queen's University Belfast. Another option is to better engage with university alumni who have participated in such programmes.

2.4 Ecosystem Exchange Activity (Glasgow)

The final workshop of this series was held at the University of Strathclyde as part of the Engage@Strathclyde week on 1st May 2018. The event was designed as an exchange activity with a poster session and networking lunch for a) HEI and non-HEI staff who are running activities that link academics, students or alumni to entrepreneurs and resource providers in the university's wider entrepreneurial ecosystem and b) HEI staff who have strategic or management responsibility for the interface between the university and its entrepreneurial ecosystem.

A general call for posters was published and an invitation was sent to all participants of previous workshops to attend this event and present their activities. We received poster contributions from seven institutions and attendees from more than ten institutions across Scotland, including four HEIs represented for the first time in the workshop series. In an informal setting, this event provided unique insights into a range of different activities for entrepreneurial staff, students and alumni that enhance entrepreneurship ecosystems in HEIs from the people that actually operate them. The activities included entrepreneurship training, networking, and mentoring activities. The posters that were presented at this event can be found in appendix A1.

3. A Framework for Growing University Ecosystems

Entrepreneurship is a key driver for economic development through creative destruction and new forms of competitive advantage (Schumpeter, 1934) as well as comparative advantage and self-discovery (Hausmann & Rodrik, 2003). However, entrepreneurship does not happen in isolation and the role that the socio-economic context plays in enhancing or inhibiting entrepreneurship is increasingly recognised in the academic literature (Autio et al., 2014; Welter, 2011). In an attempt to explain the highly skewed distribution of innovative and entrepreneurial activities (Balland & Rigby, 2017), systemic approaches were introduced to understand the entrepreneurial dynamics within regions (Neck et al., 2004).

This led to the entrepreneurial ecosystem concept, which was originally defined as "an interconnected group of actors in a local geographic community committed to sustainable development through the support and facilitation of new sustainable ventures" (Cohen 2006, p. 3) and then widened to include all ventures. The concept first gained traction among practitioner communities (Isenberg, 2010; Feld, 2012), before being adopted and used as a theoretical lens in the academic literature (Stam, 2015). The entrepreneurial ecosystems literature emphasises the importance of interdependencies and reinforcing feedback effects among cultural, social, and material attributes (Spigel, 2017; Autio and Levie, 2017).[3]

HEIs contribute to entrepreneurial ecosystems and regional economic development in many ways, including education, spin-offs, staff and student start-ups, and collaborations with existing businesses, particularly in knowledge-intensive sectors (Audretsch, 2014; Bercovitz & Feldman, 2006; Bramwell & Wolfe, 2008). HEIs are often the centre of entrepreneurial activity, especially in regions with less mature entrepreneurial ecosystems (Graham, 2014). Even in well-developed regions, HEIs have developed their own entrepreneurial ecosystems, which can be thought of as nested within wider city or regional entrepreneurial ecosystems.

HEI entrepreneurial ecosystems are the result of the "strategic and collective actions of various organizational components […] in order to maximize both the entrepreneurial and innovative contributions of universities" (Hayter, 2016, p. 634). Sustainable HEI entrepreneurial ecosystems depend on various stakeholders "who share the same goal of entrepreneurial support within a local geographic community and who are associated with a specific university" (Theodoraki, Messeghem & Rice, 2018, p. 155). Key identifiers of the emergence of a HEI entrepreneurial ecosystem include (Siegel & Wright, 2015a, p. 585):

[3] The entrepreneurial ecosystem concept is still under-developed and under-theorised (Stam, 2015), but research on this topic is growing very fast. For further information and current debates visit the Entrepreneurship Ecosystem Research Network at http://eernetwork.org.

1. the rise of property-based institutions, such as incubators / accelerators and science / technology / research parks, to support technology transfer and entrepreneurship;
2. substantial growth in the number of entrepreneurship courses and programmes on campus (in multiple colleges / schools);
3. the establishment and growth of entrepreneurship centres;
4. a rise in the number of 'surrogate' entrepreneurs on campus to stimulate commercialization and start- up creation; and
5. a rapid increase in alumni support of various aspects of this entrepreneurial ecosystem, including alumni commercialization funds and student business plan competitions.

Successful HEI entrepreneurial ecosystems share five distinct factors (Graham, 2014):

1. strong HEI senior management who actively promote the entrepreneurial agenda and foster links among staff, students, and the external environment;
2. an academic culture within departments that supports and rewards entrepreneurial behaviour and entrepreneurial champions as role models;
3. collaboration among different stakeholders and support from various organisational units within the HEI throughout the whole entrepreneurial process;
4. a bold, ambitious, innovative, and highly connected community of entrepreneurial students, mentored by senior staff members and entrepreneurs; and
5. long-term and mutually-beneficial relationships with external partners and companies, who take an active role in the university life.

The latter underlines the need for HEIs to not only develop internal support structures and initiatives, but also to establish and maintain linkages to the regional entrepreneurial ecosystem and national and global innovation ecosystems. Research-intense universities in particular are often involved in or even at the centre of small but highly connected knowledge ecosystems (Clarysse et al., 2014) or innovation and platform ecosystems (Autio & Thomas, 2014; Nambisan & Baron, 2013; Scaringella & Radziwon, 2018).

The ecosystem approach provides a more holistic framework and challenges the traditional design and understanding of policies, structures, and incentives, as isolated items and artefacts. In particular, an ecosystem perspective recognises that (Autio & Levie, 2017):

1. knowledge of the inner workings of the ecosystem is distributed across multiple stakeholders, whose localized, often one-to-one, interactions collectively coproduce ecosystem-level outcomes;
2. actions taken by stakeholders can have direct and indirect cascading effects within complex causal chains, some of which may be mutually reinforcing;

3. the stakeholders may be imperfectly aligned, both in goals and activities;
4. their interlocking relationships, combined with imperfectly distributed information, can produce a high level of inertia.

Recognising these challenges, we propose a process model, as illustrated in figure 3, to help universities structure and streamline their efforts in nurturing their internal environment and connecting to the wider entrepreneurial ecosystem within which they are embedded.

In section 4, this framework is explained in more detail and three recommendations are presented to enhance HEI ecosystems. In section 5, three more holistic points for action for universities are proposed to ensure sustainability and effectiveness of their initiatives and policies.

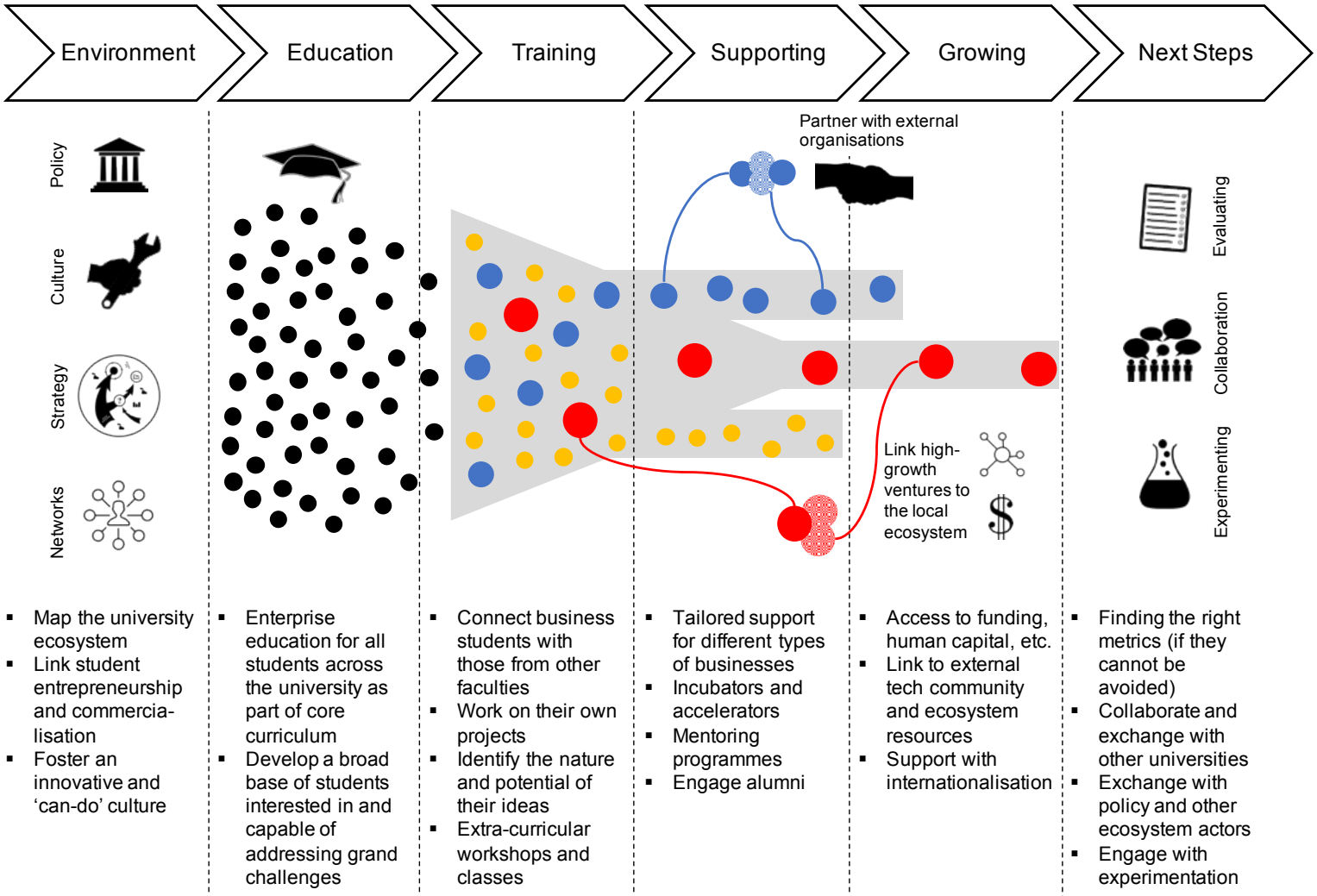

Figure 3: Framework for growing university entrepreneurial ecosystems

4. Recommendations for HEIs

HEIs are subject to a variety of tensions, requiring them to balance their social obligations of teaching and education and basic research for the benefit of society, with demands for 'ecosystem services' such as applied research, professional training and support of local, regional and national organisations. Growing demand for HEIs to foster enterprising and entrepreneurial behaviour among staff, students, alumni and local citizens is one example of this tension (Feller, 2017; Florida, 1999; Paleari, Donina & Meoli, 2015). In order to successfully integrate the growing demand for these ecosystem services with their other goals and expectations, we make three key recommendations for HEIs.

4.1 Create a Supportive Environment

We recommend that HEIs work to understand and govern their ecosystem and create a supportive environment within which entrepreneurial ecosystem services can flourish (see figure 4). This environment includes an entrepreneurial and innovative culture; policies that support and reward entrepreneurial activities; and efforts to connect staff, students, and alumni; all coordinated and promoted through a clear vision and strategy.

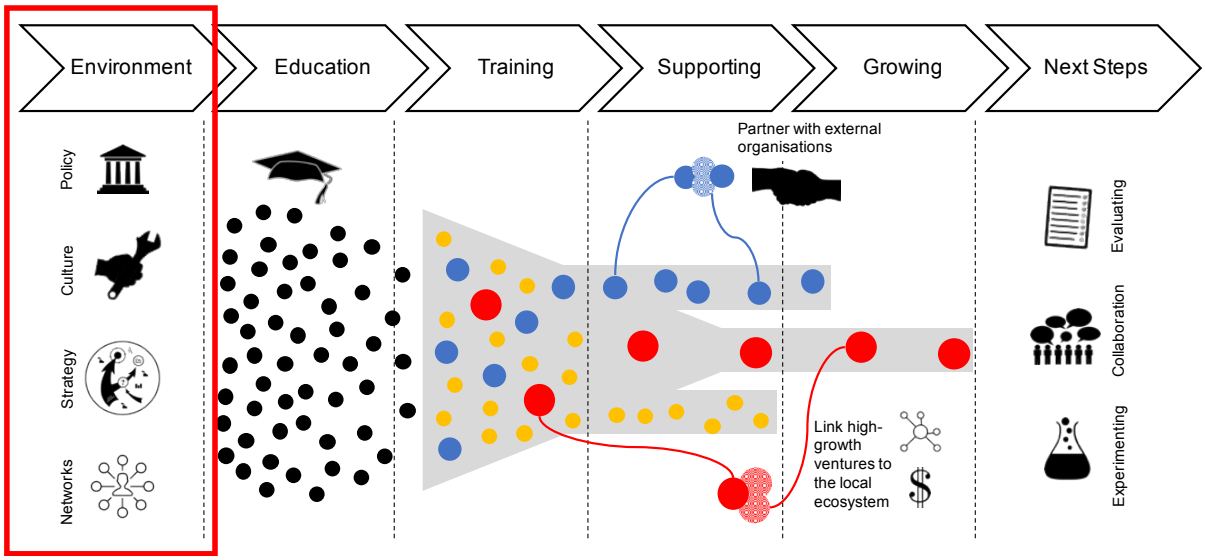

Figure 4: Create a supportive environment

A first step is to map the components of the university ecosystem, internal and external linkages, potential conflicts, and where similar tasks are performed by different people or organisational units (e.g. support for knowledge exchange and technology transfer within

different faculties). The first workshop revealed that there is no “right” or “wrong” approach in terms of how to map the ecosystem, but it is essential that this is a collaborative activity, with the active involvement of relevant department and individuals. This map provides a first overview of the state of the ecosystem and should be seen as a working document. ‘Mapping’ could become a routine activity where, at regular intervals, stakeholders of the ecosystem update each other on what they are doing and what they intend to do next.

Any changes to policies, support structure, educational guidelines, or incentive schemes should reflect a holistic strategy which, while defining the broad vision and charting the general direction, should be sufficiently flexible to accommodate experiments. The strategy should link student entrepreneurship to commercialisation, spin-off creation, and general knowledge exchange activities and alumni engagement but also research themes (e.g. based on societal challenges) and the general positioning of the university. Student entrepreneurship, commercialisation efforts and alumni engagement are often seen as separate issues. While these activities often require different types of support, many synergies can be generated across them.

Lastly, all these efforts combined are important for an entrepreneurial culture throughout the HEI, with bold and ambitious staff, student and alumni communities that are not just well-connected internally but also closely linked to each other. This is the basis of a ‘can-do’ attitude and a shared drive to change society for the better.

4.2 Develop Clear Internal Pathways

With a supportive and entrepreneurial environment as the basis, HEIs should develop clear internal pathways for entrepreneurial staff, students and alumni and constantly monitor their effectiveness and adjust if necessary (see figure 5). Many universities offer a variety of programmes and different ways of supporting entrepreneurial staff, students and alumni (for a wide range of examples, see the posters from workshop 4 in appendix A2). The challenge for most universities is to provide a clear path for staff, students and alumni in order to help them navigate through the available support opportunities and resources.

While most HEIs have developed opt-in curricular and/or extra-curricular pathways for entrepreneurial students, a truly ambitious pathway for students would embrace the concept of ‘enterprise for all’, i.e. the implementation of a HEI-wide enterprise education programme as part of the core curriculum for all students. The potential benefits of a successful

implementation are significant, both for the recipients and the HEI itself[4]. At the level of the university and beyond, the strategic goal of enterprise education is to increase the entrepreneurial and intrapreneurial output of its graduates (Lord Young, 2014). Roughly one in every two high school leavers in Scotland goes on to attend further or higher education, so 'enterprise for all' could have a significant effect on the next generation.[5]

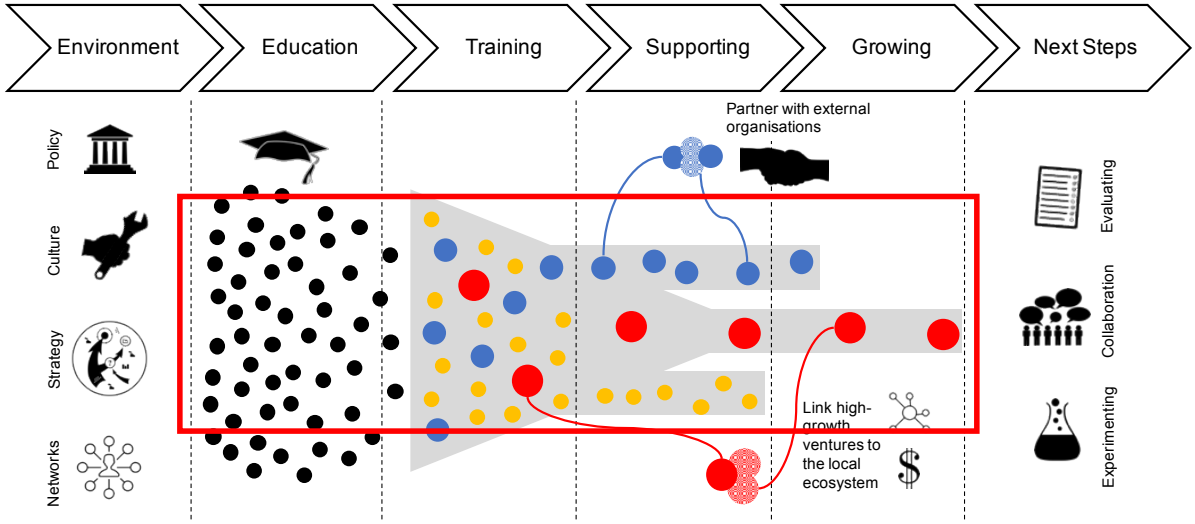

Figure 5: Develop clear internal pathways

On top of this, Scottish graduates increasingly face competition for job positions from a growing pool of international graduates, while the job market is changing rapidly, requiring candidates to be more enterprising in the way they forge their own career paths. Anecdotal evidence suggests that many of today's students have already embarked on portfolio careers: as well as being full-time students, they may have several part-time jobs and/or a part-time (often digitally-enabled) business. Any opportunity for candidates to stand out in the job market will be beneficial, and enterprise education is well placed to provide this differential. Regardless of discipline, students should gain in confidence and competence as a result of enterprise for all, and its interdisciplinary nature will help prepare them for the world of work. In return, the HEI will be well placed to benefit from future alumni engagement. In addition, a fully embedded and successfully implemented enterprise education system fosters an innovative and entrepreneurial culture within the university and should result in the creation of more student-led start-ups and tighter links with entrepreneurial alumni.

[4] There is a potentially lucrative consultancy or franchise market for HEIs that successfully implement their own enterprise for all programmes, with Prof Gibson highlighting China and the Middle East as growing markets. During the third workshop, Prof Gibson also suggested that the UK is well positioned to take the lead here.

[5] For further information see http://www.gov.scot/Topics/Statistics/Browse/Lifelong-learning/API0809

Depending on which departments – and, hence, which students – get involved, these might also include high-growth potential technology start-ups. These potential entrepreneurs are shown as black dots in figure 5.

The challenges of delivering university-wide enterprise education are well understood by those already involved in the sector, as group discussion signified in the third workshop. Prof Gibson covered three core obstacles during his talk: (1) resistance from colleagues to take on board additional work; (2) difficulties in finding subject-specific enterprise educators able and willing to produce and deliver course content; (3) difficulties in developing suitable pedagogy.

On top of a broad enterprise education programme, an ambitious pathway would include entrepreneurship education and training programmes that are narrower in scope. These would be experiential, action-based, and could be credit and/or non credit-bearing. Entrepreneurship education has evolved significantly (Kuratko, 2005) and, even more than enterprise education, raises awareness of and induces a positive attitude towards self-employment and entrepreneurship and also provides relevant tools and techniques (Athayde, 2009). While not for everyone, it should be seen as an important part of a systemic effort to enhance a HEI's entrepreneurial ecosystem (Bischoff, Volkmann & Audretsch, 2018).

Entrepreneurship education and training can be offered by academics, by alumni, or by HEI staff (for example in TTOs, careers offices or alumni and development offices) or subcontracted to external support organisations such as accelerators or the Scottish Institute for Enterprise and should also feed into competitions such as the Converge Challenge and Scottish Edge. Entrepreneurship education should be based on "learning-by-doing" group activities, use students' ideas and inventions and involve local/regional role models and entrepreneurs (for a discussion in the literature see e.g., Levie, 2014; Rasmussen & Sørheim, 2006; Siegel & Wright, 2015b). For example, many universities have developed programmes and courses that group business students with those from science and engineering faculties to work collaboratively on commercialising inventions.

At this stage, it is also important to distinguish between different types of businesses, such as lifestyle businesses (indicated as yellow dots in figure 5), technology-based businesses and, generally, those with a higher growth potential (indicated as blue and red dots). The fourth workshop has also highlighted the need for special training and additional courses for artists and students that are likely to work as freelancers (e.g. focus on legal and operational aspects of being a freelancer).

Following the 'Training' phase, figure 5 includes three exemplary support routes for potential entrepreneurs. After founders or founding teams, their ideas, and their potential have been

identified, universities should provide clear pathways to support these ventures. The amount of support that these different types of businesses need is illustrated by the length of the path. For example, lifestyle businesses need support in the early stages but do not need further growth support, unlike technology-based businesses that have the potential to become scale-ups or even unicorns (red).

4.3 Link Internal Pathway to the Wider Ecosystem

Technology-based ventures typically need more resources (e.g. specialist market knowledge or venture capital or other forms of investments) than a HEI on its own can provide. At the other end of the spectrum of external resource need, artists and freelancers can also benefit from connections to the wider ecosystem, such as mentoring from successful entrepreneurs (who could include alumni). HEIs and other actors in the wider ecosystem should "work together to view social networks as a strategic asset important for technology commercialization and economic development" and use existing networks and new collaborations to provide additional support for the entrepreneurial community at the university as well as external entrepreneurs that can benefit from interacting with the university ecosystem (Hayter, 2016, p. 653).

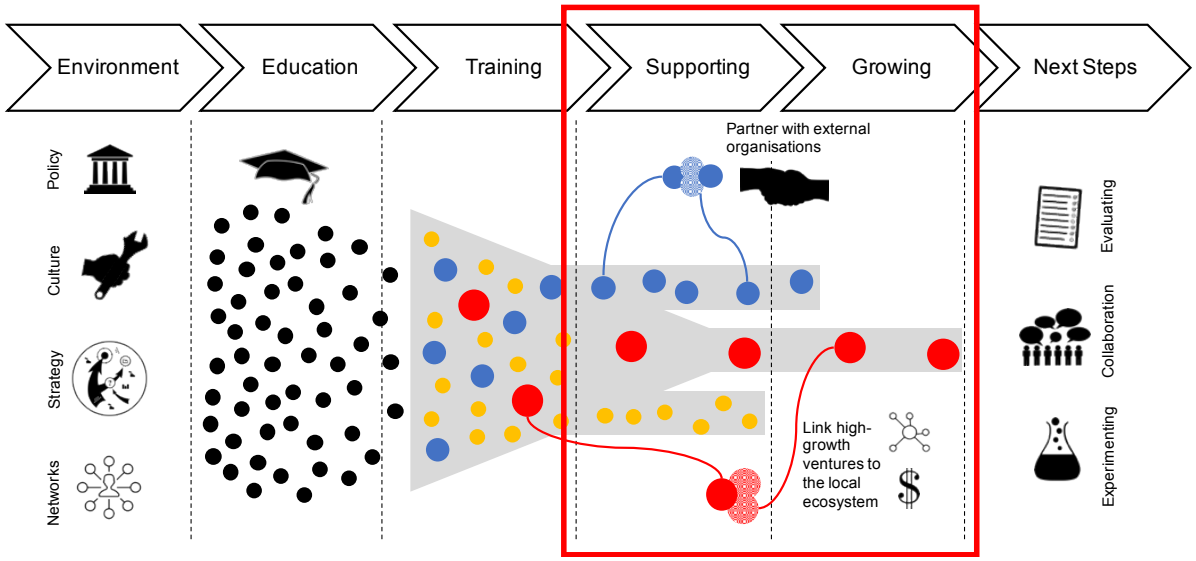

Figure 6: Link internal pathways to the wider ecosystem

In Scotland, there are a number of regional and national support programmes available. These programmes not only provide direct support for entrepreneurs or and those who want to become entrepreneurs, but also raise entrepreneurial intention and ambitions among the wider student population (Souitaris, Zerbinati & Al-Laham, 2007). They also support the development of networks among students, academics, and non-academic staff (Yi & Uyarra, 2018). For HEIs, it is important to include these opportunities in the internal pathways and

show how external organisations (e.g. Scottish Institute for Enterprise, Converge Challenge, Scottish Edge, accelerators etc.) can be valuable, to whom they are of value, and how and when this fits within the internal pathway.

This is illustrated in figure 6, where high-potential ventures or business ideas (red and blue dots) graduate from the internal university pathway and receive funding or work with other external partners. This also offers them an opportunity to work with and learn from other businesses (indicated as stripy blue and red dots).They may re-enter the university pathway again, but many businesses will soon outgrow the university support structures.

These types of collaborations and linkages to the entrepreneurial ecosystem are not only beneficial to the new venture but also the university and the wider ecosystem. A recent survey by the ScaleUp Institute has highlighted that the CEOs of high-growth businesses in the UK are aware of the importance of people and places, locally-rooted resources, and value local networks and support even if there are national initiatives (ScaleUp Institute, 2018). A potential mechanism to foster engagement with other companies in the ecosystem is the activation of alumni networks. An example is the Strathclyde 100 initiative.[6] Finally, such networks are essential for a successful entrepreneurship education programme (Bischoff, Volkmann & Audretsch, 2018, p. 39).

[6] For further information see https://www.strath.ac.uk/whystrathclyde/strathclydeentrepreneurialnetwork/eventsactivities/strathclyde100/

5. Next Steps for HEIs

The previous recommendations have outlined how HEIs can foster their own entrepreneurial ecosystem and improve their connectedness to the local/regional entrepreneurial ecosystem. This section extends those three recommendations and provides a more holistic perspective for HEIs as a group. Three steps are suggested with the aim of allowing Scottish HEIs to sustainably manifest their position in the wider entrepreneurial ecosystem, implement sustainable policies and structures that link to current national policies, and incorporate lessons that other institutions have learned from experience.

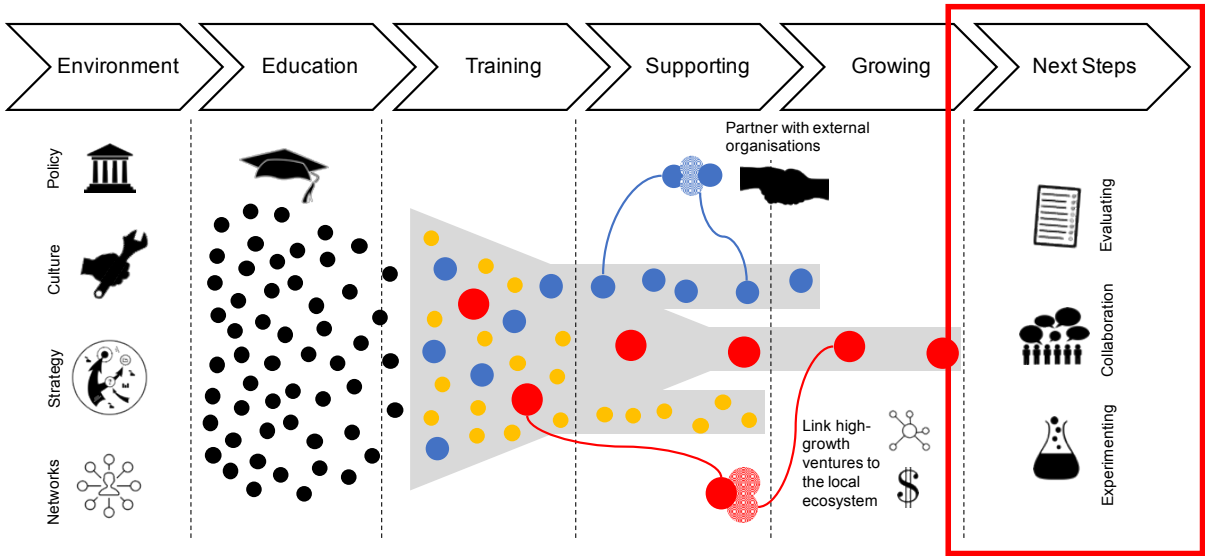

Figure 7: Next steps for universities

5.1 Collaboration and Sharing Best Practices

The Scottish HE sector has a long history and international reputation for being innovative and entrepreneurial. Many Scottish HEIs have developed new structures and incentives to encourage and support innovative and entrepreneurial behaviour (Universities Scotland, 2018a). However, this workshop series has confirmed the value of further interaction and cross-institution collaboration among individuals engaged in their institution's enterprise agenda, not just at senior policy-making level, but at the coal face of programme delivery. While innovativeness at the university level is a necessary ingredient, it is not sufficient. If universities, like other ecosystem stakeholders, are too focused on their own activities and policies, they could miss the benefits of learning from experimentation elsewhere, wastefully replicate ecosystem services already available from other stakeholders, be misunderstood and undervalued by other ecosystem stakeholders, and run the risk of falling into a strategic 'black hole' (Sotarauta, 2016).

Strategic black holes can occur when the institutional embeddedness is not accounted for properly and superficial connections are promoted, while previous successes are simply copied rather than properly analysed and transformed into systemic and sustainable transformations of the ecosystem (Sotarauta, 2016). They often occur when there is a disconnect between those who plan strategy and those who deliver activities and generate outputs.

An example of a mooted initiative that could have become a strategic black hole is an idea that was discussed during the second workshop: a Scotland-wide summer accelerator programme similar to the MIT Global Founders Skills Accelerator. This accelerator would involve the most promising entrepreneurs from all universities and feed into the Converge Challenge. Since this idea was mooted, many more accelerators have sprung up across the country, some in partnership with universities, and funders such as Converge Challenge and Scottish Edge have ramped up their own pre-accelerator activities. While this idea appeared to meet a need at the time, and was investigated further, the need for it declined as other actors began filling in the gap in ecosystem services space that this accelerator would have occupied. Had it become a firm commitment of a national strategy, it might have been obsolete before it started.

By connecting with other actors at different levels and sharing best practices across institutions, HEI entrepreneurial ecosystem managers can gain a much deeper understanding of how their ecosystem works, the cascading effects within the complex interdependencies of the ecosystem, and also its latent potential (Autio & Levie, 2017). A concrete example is the case of tailored entrepreneurship education and training. A consensus was reached among workshop participants that a platform can be valuable for sharing experiences and different practices to find the best design for such training and how this could also expand to include students from other social sciences, law, or the arts and humanities. Currently, sharing takes place on an adhoc basis, for example through general calls for syllabi in fora such as the Entrepreneurship Division of the Academy of Management, or special interest group meetings of the Institute for Small Business and Entrepreneurship.

5.2 Evaluate Learning, not Output

Many stakeholders in HEI entrepreneurial ecosystems are interested in the performance of their ecosystem and the return on their investment in it. Over the years, many metrics have been developed, most of which are related to the quantity of entrepreneurship in one way or another (e.g. the number of start-ups). Metrics are, however, a double-edged sword. On the

one hand, a university's entrepreneurial measures can have a positive effect on the perceived entrepreneurial climate by students (Bergmann et al., 2018) and can provide incentives and a shared goal. On the other hand, most metrics lead universities and institutions to *play the game* or *widen the focus* to escape the metrics.

The standard metrics have been aptly described as "convenient to collect, keep the funding bodies happy but do not tell you much about what is really happening", in addition to being easy to manipulate and highly sensitive to individual blockbuster events (Graham, 2014, p. 8). Many academics also perceive their university's entrepreneurial strategy to focus on revenues first (and on addressing the metrics) instead of creating value for society, which is then also reflected in the metrics and strategy for student and graduate entrepreneurship (Welsh et al., 2008). Furthermore, there is no compelling evidence in the literature for the link between entrepreneurship education and new venture formation, although the evidence is stronger on self-efficacy (Smith, 2015) and on entrepreneurship training rather than on entrepreneurship education (Levie et al., 2014). The question is whether we are using the right metrics within the right time horizon?

If metrics cannot be avoided for universities, learning and education must be at the heart of all metrics and business formation (quantity of entrepreneurship) and both start-up performance (quality of entrepreneurship) should be secondary objectives. Venture creation should be seen as one but not the only means to convert entrepreneurship education into value for society and one of several ways through which students and alumni can learn to develop additional competencies and gain experiences. For example, we are only just beginning to appreciate that, in economic development terms, intrapreneurship may be more productive form of entrepreneurship than autonomous new venture creation in northern European countries (Ali et al., 2016). Furthermore, entrepreneurship and value creation are not linear processes; they take time. among others. For students, this can go well beyond their graduation and it can take a recent graduate more than three years from idea to actual business formation. It is very difficult to reflect this in the metrics and it underlines the need for universities to be measured primarily against learning and education, not the rate of business formation within a certain time period. An overview of a broad range of potential metrics can be found in appendix A3. An alternative, self-assessment, approach is offered by heinnovate (https://heinnovate.eu/en), and this could form a useful basis for internal discussion by stakeholders across a HEI's entrepreneurial ecosystem or even form the basis for a further cross-HEI ecosystem workshop.

5.3 Engage in Ecosystem Experimentation

A longitudinal study of MIT graduates by Hsu, Roberts and Eesley (2007) has shown that venture creation is correlated with changes in the entrepreneurial ecosystem that surrounds the university. This external environment and the cultural context also shape entrepreneurial reasoning (Laskovaia, Shirokova & Morris, 2017). Almost two thirds of graduate start-ups in Sweden are founded in close proximity to the university; this likelihood further increases a) in metropolitan areas, b) if the former student was born in the same area, or c) when family and other entrepreneurs are co-located (Larsson et al., 2017). This shows that HEIs can advance their own ecosystem and are often the centre of the regional ecosystem in lagging regions, but ultimately, they cannot and should not do it all and need to collaborate with government and other ecosystem stakeholders. Due to the wide variety of starting conditions, a high level of adaptation would be required to tailor general prescriptions to a particular HEI. This makes economic experimentation and flexible implementation of strategies almost inevitable.

Several ideas which could encourage ecosystem experimentation were raised at the workshops. One idea was to gather a small group of up to 10-15 experts, including representatives from Scottish universities, who are assigned for a fixed term, and have a certain budget of around £1-10M to "just do things". This panel should not be judged by any metrics, rather their decisions should be well documented and provide insights for other organisations and institutions. A related but more inclusive (and transparent) approach could be to use the fund for novel experiments designed to enhance one or more HEI (or FEI) entrepreneurial ecosystems, where transparency of outcomes is a condition of the competition. Rather than relying on a small number of experts to come up with novel ideas, all staff, students and alumni of Scottish HEIs (and FEIs) would be eligible to apply and the experts would allocate funding. Ideas that combined existing resources within or across several HEI ecosystems could be particularly encouraged. The results of the experiment would be published and publically available to replicate or avoid, depending on the outcome of the experiment. This initiative might provide an ideas engine that would encourage building on existing resources and enable the flexible implementation of strategies through grass roots initiative, thus avoiding strategic black holes that have been observed in peripheral regions attempting to shift their innovation and entrepreneurial ecosystems (Nieth et al., 2018). It would also serve as a source of ecosystem resilience, helping Scottish HEIs to adapt their entrepreneurial ecosystems to changes in their environment (Bunker Whittington, Owen-Smith & Powell, 2009; Huggins, Johnston & Steffenson, 2008).

6. Conclusion

Scotland has an ambitious goal to become a world-leading entrepreneurial and innovative country. A key component in this endeavour is its HE sector. The workshops in this series have focused on mapping individual HEI ecosystems, the role of accelerators and incubators, enterprise education, and an exchange activity of best practices. These topics were discussed and agreed upon by the UHLTG and many of the activities that were presented at the final workshop and the issues that were raised during the discussions between those who deliver these activities for their HEIs are related to those raised in previous workshops. While a small series of workshops and events cannot cover all challenges and opportunities, this is nonetheless a testimony that this event series has addressed at least some of the key issues for Scottish universities.

Feedback from all four workshops was very positive. Overall, participants recognised the value in working with like-minded people from different organisations, the opportunity to make new connections, establish relationships, and to exchange ideas, best practices and learn from each other. Networking and discussions at the workshops have already resulted in new collaborations among universities. In addition to summarising and synthesising the insights from the four workshops, this report could also serve as a basis for future workshops and exchange activities for Scottish HEIs.

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Appendices

A1. E-Factor Survey

Participants are asked to rate themselves on a scale of 1-7 in terms of how frequently they demonstrate certain behaviours, with 1 being 'almost never', 4 being 'generally', and 7 representing 'almost always'.

1: Creativity & Innovation – the ability to spot opportunities and challenges to continually innovate

Absorbs and uses new ideas and information quickly
1 2 3 4 5 6 7
Sees the future with clarity
1 2 3 4 5 6 7
Finds new ways to get better results from limited resources
1 2 3 4 5 6 7
Is good at judging which ideas to develop
1 2 3 4 5 6 7
Comes up with a lot of new ideas and ways of working
1 2 3 4 5 6 7

Sub-Total

2: Outcome & Action Orientated – the ability to think strategically and to respond flexibly to feedback

Focuses directly on what needs to be done
1 2 3 4 5 6 7
Takes risks that others would not attempt
1 2 3 4 5 6 7
Persists when others would give up
1 2 3 4 5 6 7
Pushes self and others for results
1 2 3 4 5 6 7
Willing to bend and break the rules to overcome obstacles
1 2 3 4 5 6 7

Sub-Total

3: Assertion & Negotiation – the ability to get the best deal for yourself and your business

Effectively counters objections to his/her proposals
1 2 3 4 5 6 7
Is prepared to say what he/she thinks
1 2 3 4 5 6 7
Is flexible and changes tack to win his/her way
1 2 3 4 5 6 7
Has a good sense of timing
1 2 3 4 5 6 7
Is comfortable working alone against the odds
1 2 3 4 5 6 7

Sub-Total

4: Personal Marketing – the ability to market yourself and to research the market for maximum results

Wins peoples' attention by communicating a compelling message
1 2 3 4 5 6 7
Makes things happen for him/her self
1 2 3 4 5 6 7
Listens and notices what other people need and want
1 2 3 4 5 6 7
Willing to ask for work
1 2 3 4 5 6 7
Anticipates how he/she can meet other people's need
1 2 3 4 5 6 7

Sub-Total

5: Financial Acumen – the ability to manage your financial affairs strategically and to leverage the best returns

Soundly evaluates the financial implications of a proposal
1 2 3 4 5 6 7
Highly numerate
1 2 3 4 5 6 7
Makes realistic assumptions about the marketplace
1 2 3 4 5 6 7
Is constantly looking for better deals and returns
1 2 3 4 5 6 7
Willing to take calculated financial risks
1 2 3 4 5 6 7

Sub-Total

6: Leadership & Teamwork – the ability to lead teams and projects on a collaborative basis

Involves others in almost all important decisions
1 2 3 4 5 6 7
Builds on other peoples' ideas
1 2 3 4 5 6 7
Takes responsibility for tough decisions
1 2 3 4 5 6 7
Lets people know where they stand
1 2 3 4 5 6 7
Creates a compelling picture of the future
1 2 3 4 5 6 7

Sub-Total

7: Personal Mastery & Confidence – the ability to master your own beliefs and emotions as a resource

Recognises and learns from his/her mistakes
1 2 3 4 5 6 7
Takes criticism well
1 2 3 4 5 6 7
Composed when taking risky decisions
1 2 3 4 5 6 7
Makes sound decisions quickly
1 2 3 4 5 6 7
Seizes opportunities
1 2 3 4 5 6 7

Sub-Total

8: Networking & Selling – the ability to influence events and others by selling and communicating

Sets his/her proposals in the wider business context
1 2 3 4 5 6 7
Is aware of rival products and competitors
1 2 3 4 5 6 7
Acts with customers in mind
1 2 3 4 5 6 7
Good at sizing people up
1 2 3 4 5 6 7
Gains support from others
1 2 3 4 5 6 7

Sub-Total

Grand Total

A3. Potential Metrics

1. Input indicators: institutional approach

1.1 University policies and activities:

- Extent to which knowledge transfer and E&I activities are apparent within each school/centre in the university
- Connections between the E&I activities/policies across the university
- Whether the university has sought to employ international experts in E&I to deliver programs
- Breadth of activity/resources in place at the university (e.g. incubator/accelerator, student competitions, proof of concept centre)
- Level of university resource allocated to university/industry interactions
- Extent to which innovation and entrepreneurship are considered in faculty recruitment/promotions procedures
- Whether opportunities are offered by the university for partnership with regional companies

1.2 Education and development opportunities offered:

- Amount of curricular time devoted to entrepreneurship and innovation across all engineering and physical science disciplines
- Whether entrepreneurship and innovation training are offered to all university employees (including post-docs)

2. Process indicators: entrepreneurial culture and innovation capacity within the university

2.1 Individual student/staff attitudes and aspirations:

- Student and staff career intentions and options (self reported)
- The prominence of faculty entrepreneurs as role models
- The extent to which peer entrepreneurial talent is recognised and admired amongst the student body
- Percentage of engineering/technology students and staff involved in voluntary entrepreneurship and innovation activities
- Whether student and staff participation in voluntary entrepreneurship activities is increasing
- Faculty attitudes towards and level of trust in the university technology transfer office (or equivalent)
- Percentage of faculty engaged in disclosures/patenting activity

2.2 Connectivity and university/industry engagement:

- Levels of web connectivity between the university and industry
- Number of students who combine study with jobs with high-tech firms
- Proportion of engineering/technology students undertaking industry-based projects
- Numbers of joint publications between faculty and industry
- The number of joint university/industry initiatives launched (for any purpose)
- Involvement of practitioners in teaching and mentorship (numbers of professors of practice, entrepreneurs in residence etc.)
- The free movement of faculty in and out of the university
- Growth in external attendee numbers (professional service providers, industry and investors) at networking events
- Number of university patents that are transferred to industry partners at no cost
- Amount of pre-transactional interaction with industry (i.e. engagement that it not directed at securing a contract or licence)

2.3 Relevance and quality of university research:

- Volume of industry-sponsored research (for some, this should be measured as a percentage of the total R&D budget)
- Average impact factor of faculty publications
- Volume of faculty consultancy with industry (measured by both the percentage of faculty engaged and by the total income)
- International league table ranking for university

3. Output indicators: Ecosystem impact

3.1 Technology transfer office throughput (from university generated IP):

- Number of disclosures and patents
- Number of start-ups/spin-offs
- Number of licences or licensing success rates (number of licences per year/number of invention disclosures)
- Number of licences bearing royalties
- Income generated from licences

3.2 The creation of sustainable companies (from university generated IP):

- Company survival rate after 10-15 years
- Numbers of companies with more than 20 employees (for some, total number of jobs created by companies)
- Total money raised from external investors (for some, this should be measured as a percentage of research income)
- Total sales in the marketplace resulting from commercialisations
- Total financial value of the companies created

3.3 The impact of the university graduates:

- Percentage of alumni remaining in or returning to ecosystem
- Percentage of graduates working in technology-related businesses
- Percentage of alumni (aged 30-40) engaged in starting new companies or engaged in innovation (self-reported)
- Wealth created by companies founded by university graduates

3.4 Broader development of the ecosystem and beyond:

- Whether people (companies, entrepreneurs, investors, professional service providers) are moving into the region for opportunities
- Growth rate of all startups and high tech companies in the region (job growth, new investment etc.)
- The extent to which university PhD students are employed by startup and new companies in the ecosystem
- Total employment generated by the ecosystem
- Whether the university attracts entrepreneurially-minded, successful and ambitious students and faculty
- Whether the university has contributed to changing policies in the country/region (such as creating national IP legislation)

Source: Graham (2000, p. 9)